

**COURSE TITLE : GROUND IMPROVEMENT TECHNIQUE**  
**COURSE CODE : 6017**  
**COURSE CATEGORY : E**  
**PERIODS/WEEK : 4**  
**PERIODS/SEMESTER: 60**  
**CREDITS : 4**

**TIME SCHEDULE**

Module	Topics	Period
1	Methods of ground improvements	15
2	Methods of soil stabilisation	15
3	Reinforced earth and geosynthetics	15
4	Consolidation and shear strength of soils	15
<b>TOTAL</b>		<b>60</b>

**COURSE OUTCOME**

Sl.	Sub	Student will be able to
<b>1</b>	1	Understand the different ground improvement techniques
	2	Understand the methods of stabilisation
	3	Understand the methods and properties of reinforced soil
<b>2</b>	1	Understand the basic concepts of geosynthetics
	2	Understand the basic concept of consolidation of soil
	3	Understand the concept of shear strength in soil

**SPECIFIC OUTCOMES**

Upon completing the study, the students should be able to

**MODULE -I**

- 1.1.0 Understand ground improvement techniques**
- 1.1.1 Identify the purpose of ground improvement techniques.
  - 1.1.2 List different methods of ground improvement

**1.2.0 Understand dewatering procedure**

- 1.2.1 Define dewatering and drainage of construction site
- 1.2.2 List objectives of dewatering.
- 1.2.3 Describe the open sump & ditch method , well point system, shallow & deep well system, vacuum method, electro osmosis methods of lowering water table.
- 1.2.4 Compare different methods of dewatering
- 1.2.5 Identify methods of dewatering for different site conditions.

**MODULE -II**

**2.1.0 Understand soil stabilisation**

- 2.1.1 List objectives of soil stabilisation
- 2.1.2 Explain mechanical stabilisation
- 2.1.3 List factors affecting mechanical stabilisation
- 2.1.4 Explain cement stabilization.
- 2.1.5 List factors affecting cement stabilisation
- 2.1.6 Explain lime stabilisation
- 2.1.7 Explain various types of bitumen stabilization.
- 2.1.8 Explain chemical stabilisation by calcium chloride and sodium chloride method
- 2.1.9 List factors influencing effectiveness of various methods of stabilization.

**2.2.0 Understand grouting in soils**

- 2.2.1 list uses of grouting
- 2.2.2 Identify basic functions of grouting.
- 2.2.3 Differentiate various grouts
- 2.2.4 Define groutability ratio.
- 2.2.5 State various properties of grouts
- 2.2.6 Explain different applications of grouting.

**MODULE -III**

**3.1.0 Understand the concept of reinforced soil**

- 3.1.1 Explain the mechanism of reinforced earth
- 3.1.2 List the types of reinforcing elements
- 3.1.3 Describe the mechanism of reinforcement-soil interaction
- 3.1.4 Explain the applications of soil reinforcement
- 3.1.5 Describe various stages of the construction of reinforced earth wall.

**3.2.0 Understand the basic concepts of geosynthetics**

- 3.2.1 List the classification of geosynthetics
- 3.2.2 Explain the functions of geosynthetics: separation, filtration, drainage, reinforcement, hydraulic barriers, surface erosion control, encapsulation, protection and Reinforced earth wall.
- 3.2.3 Identify the properties of geosynthetics – physical, chemical & mechanical.

## **MODULE -IV**

### **4.1.0 Understand the basic concept of consolidation**

- 4.1.1 Define consolidation.
- 4.1.2. List the classification of consolidation.
- 4.1.3 Describe the spring analogy model for primary consolidation
- 4.1.4 Explain the laboratory consolidation test
- 4.1.5 Explain the consolidation of laterally confined soil
- 4.1.6 Draw the e-log p curve and identify features.
- 4.1.7 Differentiate between compaction and consolidation.
- 4.1.8 Describe preloading for soil

### **4.2.0 Understand the basic concepts of shear strength of the soil**

- 4.2.1 Define shear strength of soil and explain its development
- 4.2.2 Define principal planes and principal stresses
- 4.2.3 Explain Mohr's circle
- 4.2.4 Draw the Mohr's circle and identify the features
- 4.2.5 Calculate shear strength at given plane from Mohr's circle
- 4.2.6 State the Mohr-Coulomb failure theory
- 4.2.7 Draw the failure envelop.
- 4.2.8 Explain the procedure of direct shear test.
- 4.2.9 List the advantages and disadvantages of direct shear test
- 4.2.10 Calculate the shear strength parameters from direct shear test data.

## **CONTENT DETAILS**

### **MODULE – I**

**Introduction to Ground improvement techniques:** – Purpose - Field compaction and deep compaction methods.

**Drainage and dewatering:** - well point system, shallow & deep well system, vacuum method, electro osmosis method. Comparison between methods

### **MODULE – II**

**Methods of stabilizations:** – Mechanical – Cement - Lime - Bituminous - Chemical.

Grouting:- basic functions- permeation-compaction-hydro fracture, classification of grouts- groutability ratio- properties of grouts - viscosity, stability, fluidity, rigidity, thixotropy, permanence

**Grouting applications** : - seepage control in soil and rock under dams- seepage control in soil for cut off walls – stabilization grouting for underpinning.

### **MODULE – III**

**Reinforced earth:** - mechanism- types of reinforcing elements- reinforcement-soil interaction – applications- reinforced soil structures with vertical faces Geosynthetics – types of geosynthetics – functions of geosynthetics – properties of geosynthetics.

## **MODULE – IV**

**Consolidation:** - definition- Spring analogy of consolidation -classification- laboratory consolidation test- e-log p curve - coefficient of consolidation. Preloading techniques - comparison of compaction and consolidation.

**Shear strength:-** definition – theoretical considerations: Mohr’s stress circle, principal plane, principal stresses – Mohr-coulomb failure theory – the effective stress principle - measurement of shear strength - Direct shear test – advantages and disadvantages. Calculation of parameters from direct shear test data.

## **REFERENCE BOOKS**

1. P. Purushothama Raj : Ground Improvement Technique ; Laxmi Publications (P) Ltd
2. P. Purushothama Raj : Geotechnical Engineering ; Tata McGraw Hill
3. Shashi K Gulhati & Manoj Datta : Geotechnical Engineering ; Tata McGraw Hill
4. Dr.B.C. PUnmia : Soil Mechanics and Foundation Engineereing ; Lakshmi Publication
5. Dr.Arora.K.R : Soil Mechanics and Foundation Engineering ; Standard publishers
6. A.Khan : Text book of Geotechnical Engineering ; Prentice Hall of India
7. Dr. J.Sha & S.K.sinha : Construction and Foundation Engineering ; Khanna Publishers
8. T.N.Ramamurthy & T.G.Sitaraman : Geotechnical Engineering ; S.chand Publishers.
9. Nihar Ranjan Patra : Ground Improvement Techniques ; Vikas Publishing house